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## **Blushing after a moral transgression in a prisoner's dilemma game: appeasing or revealing?**

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### *Abstract*

*This study investigated the alleged remedial effects of blushing in the context of real-time interactions. Therefore, 30 pairs of prosocial individuals participated in a prisoner's dilemma 'game'. The experiment was framed as an objective test of moral behaviour. To elicit a shameful moral transgression, one individual of each pair was instructed to select the non-habitual cheat-option on a pre-defined target trial. Supporting the idea that violation of shared rules elicits blushing, the defectors displayed a blush on the target trial. Yet, unexpectedly, there was a negative relationship between the observed blush intensity and the trustworthiness attributed to the defectors. One explanation might be that the 'victims' used the blush response to deduce and interpret the defector's motive. As the antecedent behaviour involved in the present context was not completely unambiguous with respect to the perpetrators' motive (e.g. innocent playing around vs. maximizing outcomes) the observers might have interpreted blushing as signaling that the situation should be interpreted as an intentional violation of a social standard. Together the available evidence suggests that only in the context of unambiguous antecedent behaviours blushing has remedial effects, whereas in ambiguous situations blushing has undesirable revealing effects. Copyright © 2002 John Wiley & Sons, Ltd.*

Blushing is a unique human response which predominantly occurs in face-to-face contacts involving shame or embarrassment (Shields, Mallory, & Simon, 1990). It is a very common emotional response and virtually all people blush at least occasionally (Edelmann, 1990). Blushing is not an all-or-none phenomenon, but experienced as varying in duration and intensity. Accordingly, physiological assessments indicated that individuals' facial coloration varies as a function of the intensity of self-presentational predicaments (e.g. Mulkens, De Jong, Dobbelaar, & Bogels, 1999).

The blush response is usually limited to the face (sometimes spreading to the ears, neck and upper chest; Simon & Shields, 1996; Leary, Britt, Cutlip, & Templeton, 1992), and because facial expressions play such an important role in social interactions, it is tempting to assume that social

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blushing should be considered as a functional *communicative* signal rather than a trivial epiphenomenon of (undesired) social attention (e.g. Darwin, 1989). Germane to this suggestion, it has been argued that displays of shame and embarrassment may serve appeasement-related functions (e.g. Keltner, Young, & Buswell, 1997). Publicly conveying embarrassment or shame would signify the actor's recognition that he or she has committed a social or moral infraction and sincerely regrets it. In its turn, this message may mitigate the negative social impression and evoke reconciliation-related behaviour in the observers (e.g. Tangney, Miller, Flicker, & Barlow, 1996). In contrast, failing to appear embarrassed or ashamed after violating a social/moral rule may be interpreted as indicating that the actor is not aware of or not concerned about his or her transgression.

In accordance with its alleged appeasement-related function, it has been found that (motoric) displays of embarrassment, indeed, help to restore the actor's public image after a mishap (Semin & Manstead, 1982). That is, when asked to evaluate a shopper disturbing a display tier of toilet rolls in a foodstore (which was shown on video), participants attributed more positive dispositional characteristics to the actor when he appeared embarrassed than when he did not appear embarrassed. In other words, displaying embarrassment seems effective in warding off negative attributions. Similarly, individuals depicted on a slide from whom was told that they had committed a social transgression elicited higher levels of sympathy in the observers when displaying shame than when displaying amusement or a neutral facial expression (Keltner et al., 1997).

Although there is increasing evidence indicating that there are distinct displays of embarrassment and shame (Keltner & Buswell, 1996), blushing may well occur in both embarrassing and shameful situations (Shields et al., 1990). Following this, several authors have speculated that social blushing shares appeasement-related properties with other expressions of embarrassment and shame (e.g. Cutlip II & Leary, 1993).

Consistent with such a view, it has been shown that *embarrassed* individuals who believed that the researcher did not perceive their blushes in the context of a self-presentational predicament, subsequently engaged in alternative remedial behaviours, whereas participants who thought their blushes were perceived as evidence of embarrassment, did not (Leary, Landel, & Patton, 1996). That is, these individuals acted in a way as if they realised that their blushing serves as a remedial gesture.

In a similar vein, other authors accentuated the communicative and remedial effects of blushing in the context of *shame*. An elaborate conceptualisation of the possible communicative and remedial properties of blushing in the context of shame can be found in Castelfranchi and Poggi's (1990) book chapter 'Blushing as a discourse: Was Darwin wrong?' In short, these authors argued that people are likely to blush if they violate social/moral rules which they (think to) share with the observers. In their view, blushers communicate in such situations that they are sensitive to the judgement of the observers and, at the same time, that they share the observers' values. The former would have the function to inhibiting aggression and avoiding the loss of one of the group's loyal members, whereas the latter may serve to strengthen the social rules and to underline the actor's trustworthiness (cf. de Waal, 1995). The fact that blushing cannot be voluntarily produced seems of particular relevance in this respect, as it prevents blushing from being instrumentally used (e.g. when it would be efficient to pretend shame). In other words, because of its involuntary nature the blush response may act in a way to stress the actor's sincerity in displaying shame and regret for violating a rule.

Although several authors have speculated that social blushing serves an important communicative and remedial function, thus far direct empirical evidence to support this assertion is extremely scarce. In a first attempt to empirically document the alleged remedial properties of social blushing, we recently presented participants with a series of vignettes which described embarrassing incidents that took place in a shop (cf. Semin & Manstead, 1982). In line with the idea that blushing serves a remedial gesture, the blushing actors were rated much more favourably on personality dimensions that are related to *trustworthiness* than their nonblushing counterparts (de Jong, 1999; Experiments 1 & 2).

Supporting the idea that blushing would be a relatively convincing display of embarrassment or shame (i.e. because it cannot be simulated), the remedial effects of blushing were found to be even more pronounced than those of motoric expressions of embarrassment. Moreover, blushing actors were evaluated less negatively on the more global personality characteristics which are likely to facilitate cooperation between individuals (e.g. likeability). Thus at least at the symbolic level, blushing after a social infraction is represented as a (relatively convincing) remedial gesture.

The present study was designed to extend these earlier findings in three important ways. First, the present study focuses on shameful rather than embarrassing situations to explore whether the remedial effects of blushing are restricted to the context of seemingly involuntary mishaps (e.g. de Jong, 1999), or may also be evident in the context of shameful, moral transgressions as proposed by Castelfranchi and Poggi (1990). Second, the present experiment was designed to investigate whether the appeasement conceptualisation of the blush response will also hold in the context of *in vivo* circumstances rather than imagined situations (cf. Parkinson & Manstead, 1993). Third, and perhaps most importantly, the present experimental set-up allows us to investigate not only the influence of blushing on the characteristics that are attributed to transgressors but also the observers' actual behaviour in an interactional context.

More specifically, we tested the following hypotheses that directly follow from Castelfranchi and Poggi's (1990) communicative account of blushing. First, we investigated whether violation of a shared rule, indeed, elicits a blush response in the transgressor (*hypothesis 1*). Second, following the alleged remedial function of blushing we tested the hypothesis that blushing will lead to more favourable impressions of the transgressor (i.e. more positive global evaluation and higher levels of attributed trustworthiness) (*hypothesis 2*). Finally, we investigated whether blushing after a moral transgression not only mitigates the negative social impression but would also positively affect the observer's actual (conciliatory) behaviour in real-time interactions (*hypothesis 3*). Although blushing may evoke reconciliation-related behaviours via its favourable influence on the transgressors' social impression (cf. Tangney et al., 1996), they might also be (partly) independent consequences of the blush. That is, emotional expressions may exert their influence on others' behaviour irrespective of its explicit symbolic or affective representation (e.g. De Houwer, Thomas, & Baeyens, in press). Therefore, we formulated no *a priori* predictions in this respect.

To test the experimental hypotheses, we selected a homogeneous group of individuals sharing the important social goal of cooperation (i.e. prosocial individuals). These individuals participated as pairs in a 10-trial prisoner's dilemma game (PDG). A PDG is characterised by the occurrence of two conflicting motives (cooperation versus defection) individuals experience in interdependent situations. In such a context, moral concerns with respect to cooperation are likely to be strong (e.g. Kerr, 1995). Accordingly, it has been shown that prosocial individuals' response strategy is typically guided by the aim to (a) maximise joint outcomes, and (b) restore equality in outcomes (De Cremer & van Lange, 2001; van Lange, 1999). That is, previous research showed that prosocials generally approach interdependent others in a cooperative manner and continue to do so until the interdependent other fails to exhibit cooperative behaviour (Kelley & Stahelski, 1970; van Lange, 1999). Then, prosocials turn to noncooperation in a rather unforgiving manner (van Lange, 2000). In other words, after being cheated, prosocial individuals will reciprocate by defecting themselves (i.e. exhibit 'behavioural assimilation'). One may even expect tendencies to 'overassimilation', motivated by their strong desire to restore equality in outcomes (De Cremer & van Lange, 2001; van Lange, 1999). In addition, prosocial individuals more strongly evaluate cooperative and noncooperative others (interdependents) in terms of morality than proselves and are, therefore, likely to consider noncooperative individuals as exploitative and unfair (van Lange, 1999).

Thus our participants were all individuals who deeply care about cooperative and positive interactions. To further fuel the conceptualisation of defecting as being a moral transgression, the present PDG was explicitly framed as an objective test of moral behaviour. Relatedly, each participant

was individually explained that cooperative choices were morally superior above cheating, although the latter option would result in larger financial profit for the cheater. To elicit a shameful transgression, for each pair, one individual was instructed to select the non-habitual cheat-option on a pre-defined target trial (and to cooperate on all other trials).

Within this particular context our hypotheses led to the following specific predictions: (1) defecting on the predefined target trial will result in blushing; (2) the interdependent others will evaluate the defectors less negatively as a function of the defectors' blush intensity; (3) the prosocial victims' habitual tendency to reciprocate cheating behaviour (behavioural assimilation) will be attenuated by the defectors' blush response.

## METHOD

### Participants

Participants were 58 undergraduate students of Maastricht University (faculties of Psychology, Health Sciences, and Medicine). As the vast majority of the students at these faculties are women, it would be rather difficult to find sufficient male volunteers to allow for reliably evaluating gender effects. Therefore, we preferred a homogeneous sample of female participants. They were selected from a larger sample ( $N = 248$ ) on the basis of their scores on a written version of the nine-item Decomposed Game measure (see below). Only individuals with a distinct prosocial value orientation were invited for participation. Mean age was 19.3 years (range 17–26 years). In return for their participation, participants of the experimental group received a fixed amount of 10 guilders (equivalent of approx. 4.5 Euro). The control group could earn an additional sum depending on their choices during the prisoner's dilemma game (maximally the equivalent of approx. 1.5 Euro, which was paid in natura).

### Materials and Assessment

#### *Social Value Orientation*

To assess individuals' social value orientation we used the nine-item Decomposed Games measure (Messick & McClintock, 1968; van Lange & Kuhlman, 1994). The Decomposed Games instrument has been shown to be internally consistent (e.g. Liebrand & van Run, 1985), reliable over substantial time periods (Eisenberger, Kuhlman, & Cotterell, 1992), and robust against social desirability effects and different mood states (e.g. Platow, 1992).

The measure consists of nine items, each containing three alternative outcome distributions with points for oneself and an (anonymous) other. Each outcome distribution represents a particular social value orientation. An example is the choice between alternative A: 500 points for self and 500 points for other; B: 560 points for self and 300 for other; and C: 500 points for self and 100 points for other. Option A represents the cooperative or pro-social orientation, because it provides an equal distribution of outcomes. Option B represents the individualistic option because the outcomes for self are maximised (560 versus 500) irrelative of other's outcomes. Finally, option C represents the competitive orientation because this distribution maximises the difference between own outcome and other's outcomes (Choice C:  $500 - 100 = 400$ , versus A:  $500 - 500 = 0$ , and B:  $560 - 300 = 260$ ).

Individuals are usually classified as prosocial, individualistic or competitive when at least six choices (out of nine) are consistent with one of the three orientations (e.g. van Lange & Kuhlman, 1994). Because the strength of participants' prosocial value orientation was a crucial issue in the

present experiment, we used an even more stringent criterium: only those who selected eight or nine prosocial alternatives were invited for participation in the experiment proper.

### **Prisoner's Dilemma**

The dilemma task was carried out in pairs. During the experiment, participants were facing each other and were seated on a distance of approximately 1.8 metres from each other. There was no screen in between, so participants could clearly see each other. The (female) experimenter was sitting half-way in a perpendicular position towards the participants. There were 10 trials (which was unknown to the participants). During each trial participants had to make a choice between cooperating and defecting. Participants indicated their choice by raising a green or a red sign (which was constructed on the basis of a beach tennis bat), saying 'cooperation' and 'defecting', respectively. The parametrics of the present PDG were as follows. When both participants of a pair selected the option to cooperate, both participants received the same sum of 5 quarters of a Dutch guilder (a); when both participants selected the option to defect, both participants received only 2 quarters (b); in the case of a single defector, the defecting participant received 8 quarters (c); whereas the cooperating counterpart received nothing (d). As such, these outcome distributions are in line with the prerequisites of a PDG:  $c > a > b > d$  and  $2a > c + d > 2b$  (cf. Kuhlman & Marshello, 1975). The 'rational' strategy in such a PDG is to defect, since he or she is better off defecting when the interdependent other decides to cooperate (8 rather than 5) as well as when the other decides to defect (2 rather than 0). In other words, irrespective of the interdependent other's response, one's personal outcomes are best served by defecting. The normative choice, of course, is to cooperate.

The present experiment was framed as an objective test of moral behaviour, and each participant was individually told that cooperative choices were morally superior above defecting, although the latter option would result in larger financial profit for the defector. For each pair, one individual (experimental group) was instructed to select the non-habitual defect-option on a predefined target trial (i.e. trial 4) and to cooperate on all other trials.

During the dilemma game, trial number as well as participants' scores were presented on-line on a 17-inch computer screen by means of two coloured bars (one representing the scores of the experimental participant and one those of the control person). In addition, there was a digital display, keeping record of the amount of money that was earned thus far (for each participant separately). The screen was clearly visible for both participants (approximately 1 metre distance, angle 45°).

### **Physiological Blush Response**

Cheek coloration was used to index participants' blushing and was recorded from a (modified) HP model 15230A plethysmograph transducer. To measure changes of the level of individuals' cheek coloration (i.e. level of blood pooling) rather than changes in pulse amplitude, the transducer was modified in such a way that it was d.c. coupled rather than ac coupled (cf. Shearn, Bergman, Hill, Abell, & Hinds, 1990; Mulkens, de Jong, & Bogels, 1997, 1999). The offset was individually calibrated and set at minus 3 V on a scale ranging from minus 10 V to plus 10 V.

### **Skin Conductance**

Skin conductance level was recorded from two Beckman Ag–AgCl electrodes (8 mm diameter), placed on the medial phalanges of the middle and ring finger of participants' non-dominant hand,

using the method of constant voltage (0.5 V) (see Dawson, Schell, & Fillion, 1990). The electrodes were filled with an isotonic paste following the recommendations of Fowles, Christie, Edelberg, Grings, Lykken, and Venables (1981) and connected to a Beckman Skin Conductance Coupler (type 9844). All physiological signals were sampled with a frequency of 1000 Hz by a Compaq 486 (33 MHz) computer.

### **Subjective Measures**

After each trial (and before the first), participants made several judgements by means of 100 mm Visual Analogue Scales (VASs). Although we were only interested in particular ratings (see below) all participants were asked to rate their interdependents as well as themselves for all dimensions. This was done to hide the aim of the present investigation and to conceal the fact that within each pair, each individual had a different role. We included 'intensity of the blush response', 'strength of shame' (both ranging from 0 (not at all) to 100 (very much)), 'trustworthiness' on a scale ranging from 0 (very reliable) to 100 (very unreliable), and three more global personality characteristics which are likely to facilitate the cooperation between individuals: sociability (social = 0, antisocial = 100), likeability (likeable = 0, unlikeable = 100), and sympathy (sympathetic = 0, unsympathetic = 100). (Before being subjected to the analyses, VAS scores referring to reliability, sympathy, likeability, and sociability were recoded in a such way (100 minus  $x$ ) that high scores refer to a positive meaning).

### **Procedure**

Participants were randomly assigned to the experimental or control group, with the restriction that within each pair, participants should be studying at different faculties. This was done to minimise the chance of participants being known with each other. To further minimise contact between the pairs of participants prior to the experiment, each individual was invited to a different room. They were also separately instructed by different assistants. At some points, the instructions for the experimental group were different from those for the control participants. Yet, upon arrival, both groups of participants were informed that the experiment concerned the investigation of moral behaviour. First, it was extensively explained, by using several examples, that cooperation is morally superior over defecting, although the latter type of behaviour is often profitable for the defectors themselves. Then, the assistants informed the participants that this experiment was designed to test individuals' moral behaviour. Following this, participants were familiarised with prisoner's dilemma games and with the functional (parametric) characteristics of the present task in particular.

The experimental group was then informed that they would earn a fixed sum of 10 guilders when participating in this experiment, whereas the amount of money that the other participant (control group) would receive afterwards would be completely dependent on the choices each of the participants would make throughout the experiment. They were told that there were several conditions in this research project allowing for investigating various patterns of cooperation. It was explained to the experimental group that in their case, it was required to select the defect option during the fourth trial and to cooperate on all other trials. In addition, the instructing assistant explained that neither the research assistant who would be present throughout the experiment nor their interdependents were informed about this instruction, 'so they will think that it is your own choice to defect on trial 4'. This procedure was followed to minimise the risk that participants would anticipate not being considered responsible for choosing the 'defect' option during the fourth trial.

The control group was told that their payoff during this experiment would depend entirely on the choices each of the participants would make throughout the experiment.

Following this, both groups of participants were told that we were interested not only in the type of choices they would make throughout the experiment but also in the concomitant physiological responses. They were informed that it would therefore be necessary to apply some electrodes before the start of the experiment. Furthermore, it was explained that, throughout the experiment, they would be asked to evaluate some aspects related to themselves and to their 'adversaries' by means of VASs. Meanwhile, it was stressed to both groups of participants that they were not allowed to talk to their 'adversaries'.

Following this individual instruction, participants were guided to the experimental room. The assistant who instructed the control participants guided the social-dilemma-task in the experimental room. First, she, again, shortly explained the procedure of the present experiment using a black board to illustrate the implications of all four possible response combinations. In addition, she showed the screen and how/where the current trial was displayed and illustrated how the bars and display on the screen depicted participants' actual results throughout the experiment. Then the plethysmograph and electrodes were attached. Although we were interested only in the physiological responses of the experimental group (and which were actually measured), electrodes were attached to both participants to conceal the fact that within each pair, each individual had a different role.

After the apparatus had been checked the experiment started and the assistant asked the participants to complete the first series of VASs (one series referring to themselves and one series referring to their interdependents). Following this, the assistant asked participants to prepare for raising the signs. After 5 seconds the assistant pressed a button connected to the computer which resulted in a beep. As instructed, both participants immediately raised a sign after the sound of the beep (the button press was also registered by the computer allowing the physiological data to be related to the relevant events). The experimenter fed the respective responses to the computer, which resulted in an update of the screen reflecting the participants' scores. Meanwhile, participants were asked to complete another series of VASs. When both participants had completed the VASs, the assistant, again, asked participants to prepare for making a choice. This procedure was continued until the tenth trial was finished. To allow physiological responses to wear off, there was a minimum inter-stimulus interval (between making two choices) of 30 s. After the experiment was finished, participants were paid and debriefed.

## Data Reduction and Analysis

### *General*

Because the dyad (rather than individual participant) was the unit of investigation, only those pairs of individuals were included in the final analyses with whom the experimental participant indeed cooperated on all trials apart from the fourth, and the control participant cooperated at least on the first four trials (i.e. before the experimental manipulation). All experimental participants fulfilled this requirement, yet four control participants selected the defect option before being defected themselves, resulting in 25 suitable pairs of participants (see above).

Both physiological parameters were analysed off-line by means of a specifically designed computer program (cf. Mulkens et al., 1997, 1999). For each trial, peak levels were detected within a 15 s time window that started 5 s prior to the beep sound (indicating that participants had to raise the 'defect' or 'cooperate' sign) and that ended 10 s after this beep.



In all statistical analyses we compared the responses during the target trial with those during the immediately preceding (third) trial. We used the immediately preceding trial as the baseline assessment to minimise the artefactual influence of systematic drifts (e.g. due to habituation processes) and to optimize its comparability with the target trial (e.g. with respect to novelty).

### *Validity of Manipulation*

As a manipulation check we first tested whether we were successful in eliciting shame via the experimentally induced transgression during the target trial. Therefore, we subjected the VAS ratings (of the experimental group) referring to their feelings of shame to a paired *t*-test. As an additional check we also tested whether the interdependent others (i.e. control participants) observed increased levels of shame in their experimental counterparts during the target trial. Finally, we tested whether the experimental participants' level of general arousal (i.e. peak levels SCL) reliably increased during the experimental trial (by means of paired *t*-tests), to be sure that participants were not completely indifferent/detached with respect to their choice behaviour (e.g. because they attributed their defecting to the experimental instruction).

To check whether the (experimentally induced) transgression resulted in less favourable impressions (and thus leaving sufficient room for blushing to act as a buffer), we compared the global personality characteristics that were attributed to the experimental group before and after having defected by means of a 2 Trial (3 versus 4)  $\times$  3 Characteristic (sympathy, likeability, sociability) multivariate analysis of variance (MANOVA). In a similar vein, we tested whether the trustworthiness that was attributed to the transgressors declined from trial 3 to trial 4 (by means of a paired *t*-test).

### **Hypotheses**

To test whether the transgression resulted in a detectable blush (*hypothesis 1*), we compared both the physiological blush intensity and the observed blush intensity (i.e. rated by the control participants) between trial 3 and trial 4 (by means of paired *t*-tests). To explore whether the experimental participants themselves were aware of their blush response, we also tested within the experimental group (i.e. transgressors) whether the selfrated blush intensity increased from trial 3 to trial 4.

To test whether blushing attenuates the negative influence of a transgression on the trustworthiness and more global personality characteristics attributed to the transgressor (*hypothesis 2*), Pearson *p*-*m* correlations were computed between the transgressors' blush intensity (physiological and observed), on the one hand, and global evaluation (mean of sympathy, likeability, sociability ratings) and the attributed reliability, on the other.

To test whether blushing attenuates individuals' tendency to reciprocate after being cheated (*hypothesis 3*), we compared the blush intensity (observed and physiological) of the experimental participants whose opponents continued with cooperation on the fifth trial (i.e. after being cheated) with those whose opponents discontinued cooperation and raised the 'defect' sign on the fifth trial. To explore the potential influence of other factors apart from blushing on the control participants' decision to continue or discontinue cooperation, we carried out similar analyses with respect to observed shame, attributed trustworthiness, and the more global personality characteristics.

## RESULTS

### Manipulation Check

#### *Choices*

Sustaining the validity of the decomposed game measure that we used in the present selection procedure, the vast majority of control participants selected the 'cooperate' option before being cheated by the experimental group on trial 4. Only four out of 29 participants selected the 'defect' option without being cheated themselves (i.e. before the fifth trial). Due to the purpose of the present experiment these four participants (and their experimental counterparts) were excluded from further analyses.

#### *Perceived and Observed Shame*

The experimentally induced transgression was perceived as a considerably shameful event. That is, mean self-reported shame scores (within the experimental group) were considerably higher during the target trial than during the immediately preceding trial, means being 45.6 (SE = 5.6) and 12.4 (SE = 2.8), respectively ( $t(24) = 5.7$ ,  $p < 0.001$ ). Also their interdependents (control participants) observed a stronger shame response during the fourth (target) trial than during the third trial, means being 22.6 (SE = 4.1) and 9.5 (SE = 2.1), respectively ( $t(24) = 3.22$ ,  $p < 0.01$ ).

#### *Skin Conductance Level*

Participants (of the experimental group) displayed higher skin conductance levels (SCL) during the target trial than during the preceding trial ( $t(24) = 3.82$ ,  $p < 0.01$ ), indicating that the general level of arousal was relatively high during defecting (see Figure 1).

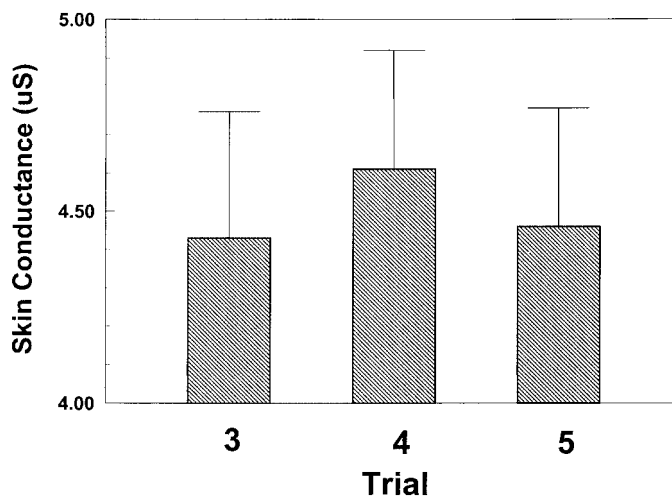


Figure 1. Defectors' maximum skin conductance level during the target trial (4) and both the preceding and the subsequent trials

*Attributed Personality Characteristics*

As intended, defecting resulted in considerably less favourable judgements of the transgressors with respect to both their more global evaluation and their attributed trustworthiness.

*Sympathy, Likeability, Sociability*

A 2 Trial  $\times$  3 Characteristic MANOVA revealed a significant multivariate effect of trial ( $F_{\text{hotelling}} = 23.1$ ,  $p < 0.001$ ), indicating that defecting resulted in a less favourable evaluation with respect to these more global personality characteristics, overall means being 90.4 (SE = 2.1) and 68.5 (SE = 4.2), respectively.

*Reliability*

The trustworthiness that the control participants attributed to their experimental opponents strongly declined after being cheated during the fourth trial. Mean attributed reliability decreased from 90.3 (SE = 1.8) to 58.0 (SE = 5.5), ( $t(24) = 5.6$ ,  $p < 0.001$ ).

**Prediction 1: Defecting on the Predefined Target Trial Will Result in Blushing***Cheek Coloration*

Peak levels of the defectors' cheek coloration as a function of trial are shown in Figure 2. A paired  $t$ -test indicated that the peak level was significantly higher during the target trial than during the immediately preceding third trial ( $t(24) = 2.70$ ,  $p < 0.01$ ). Thus the present results are in line with the idea that breaking a shared rule results in blushing.

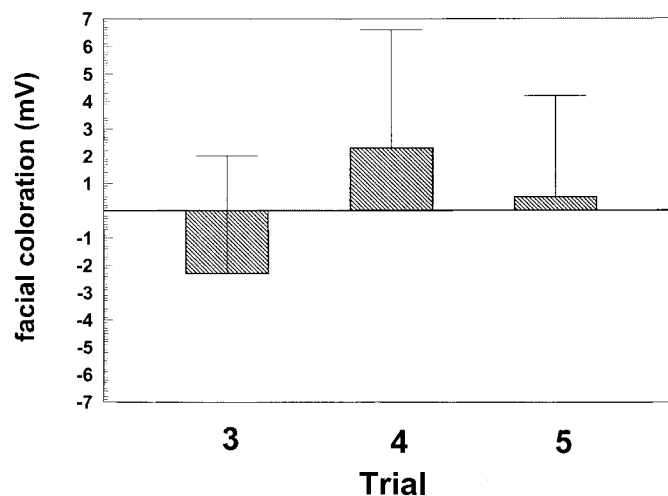


Figure 2. Physiologically registred maximum facial coloration of the defectors during the target trial (4) and both the preceding and the subsequent trials

### *Subjective Blush Intensity*

In line with the physiological assessment, the control participants observed higher blush intensities in the experimental group during the target trial than during the immediately preceding third trial, means being 23.7 (SE = 4.7) and 10.8 (SE = 2.6), respectively ( $t(24) = 2.20$ ,  $p < 0.01$ ). The self-perceived blush response of the experimental group was very similar to those observed by their (control) opponents, means being 18.1 (SE = 3.4) and 8.6 (SE = 1.5) on trial 4 and trial 3, respectively ( $t(24) = 2.8$ ,  $p < 0.01$ ).

### **Prediction 2: Interdependent Others Will Evaluate Defectors Less Negatively as a Function of the Defectors' Blush Intensity**

#### *Blushing and Global Evaluation*

To investigate the relationship between blushing and the more general characteristics attributed to the defectors, Pearson  $p$ - $m$  correlations were computed between the defectors' blush intensity (physiological and observed) and their global evaluation (mean of the of sympathy, likeability, sociability ratings) during the target trial. Yet none of the correlations approached significance (see Table 1). Thus, a relatively strong blush intensity was not found to result in relatively fewer negative global evaluations.

#### *Blushing and Defectors' Trustworthiness*

To investigate the relationship between blushing and attributed reliability, Pearson  $p$ - $m$  correlations were computed. In contrast to the predictions, there was a significant negative rather than positive correlation between observed blush intensity and the reliability attributed to the defectors (see Table 1). No significant correlation emerged between the physiological blush intensity and attributed reliability, although the physiological blush intensity correlated significantly with the intensity of observed shame.

To further investigate the relative contribution of observed blush intensity, physiological blush intensity, and observed shame to the reliability attributed to the defectors while controlling for the global evaluation and the attributed reliability on the preceding trial, a forward regression analysis was carried out. Results indicated that observed blush intensity ( $\beta = -0.45$ ,  $p = 0.02$ ) was the single best predictor of the attributed reliability. None of the other variables could explain a significantly additional proportion of variance. The proportion of variance in reliability scores explained by this variable was 21%. The negative beta value indicates that relatively strong blush responses resulted in a

Table 1. Pearson  $p$ - $m$  correlations between the reliability attributed to the defecting participants, the intensity of their blush response and their expression of shame as observed by their opponents, the global evaluation of the defectors' personality characteristics, and their physiological blush response

	Reliability	Obs. blush	Phys. blush	shame	IE
Observed blushing	-0.45*	—	—	—	—
Physiological blush	0.08	0.12	—	—	—
Observed shame	-0.17	0.42*	0.41*	—	—
Initial evaluation	0.13	-0.07	-0.41*	-0.12	—
Initial reliability	0.01	-0.13	-0.28	-0.16	0.84*

Note: \* $p < 0.05$ .

relatively less reliable impression. More detailed information concerning the (bivariate) interrelationships between the variables that were included in the regression analysis is provided in Table 1.

*Prediction 3: Prosocial Victims' Habitual Tendency to Reciprocate Cheating Behaviour (Behavioural Assimilation) Will Be Attenuated by the Defectors' Blush Response*

After being cheated on trial 4, the majority of the final group of (control) participants continued cooperation. Only, 7 out of 25 participants selected the 'defect' option on trial 5. To explore whether blushing modulates individuals' tendency to cooperate after being cheated, we compared the blush intensity of the experimental participants whose opponents continued with cooperation on the fifth trial (i.e. after being cheated) with those whose opponents raised the 'defect' sign on the fifth trial. Because of the uneven distribution of participants per cell (7 versus 18), the following ANOVA should be interpreted with care. The 2 Trial (3 versus 4)  $\times$  2 Group (Continued versus Discontinued cooperation) ANOVA revealed no significant trial by group interaction ( $F(1, 23) < 1$ ). In other words, the experimental counterparts of the participants who continued with cooperation (Con-group) did not show a relatively strong blush response while defecting. Such an interaction was also absent at the level of observed (subjective) blush intensity ( $F(1, 23) < 1$ ). Thus neither at the physiological level nor at the level of observed intensity there were any differences between both groups of defectors.

To explore whether other factors apart from blushing might have played a role in the control participants' decision to continue (Con-group) or discontinue (Discon group) cooperation, we carried out similar analyses with observed shame, attributed trustworthiness, and the more global personality characteristics. With respect to the observed intensity of shame, there were no differences ( $F(1, 23) < 1$ ). Yet a significant trial by group interaction was evident with respect to the reliability that was attributed to the experimental participants ( $F(1, 23) = 4.7$ ,  $p < 0.05$ ). Subsequent *t*-tests indicated that during the third trial there were no differences between both groups, means being 91.1 and 91.4 for the Con and Discon groups, respectively ( $t(23) < 1$ ). However, after being cheated, the Con-group reported a mean reliability score of 65.2 ( $SD = 24.5$ ) with respect to their experimental counterpart, whereas the Discon-group reported a significantly lower mean score of 39.1 ( $SD = 27.6$ ) ( $t(23) = 2.3$ ,  $p < 0.05$ ). A 2 Trial (3 versus 4)  $\times$  2 Group (Con versus Discon) MANOVA with respect to the more general personality characteristics also revealed a significant trial by group interaction ( $F(1, 23) = 7.9$ ,  $p < 0.01$ ). Subsequent one-way MANOVAs indicated that during trial 3 (i.e. before being cheated) both groups displayed very similar evaluations of their opponents ( $F(1, 23) < 1$ ). Yet after being cheated, the Con-group reported a significantly more positive evaluation of the defecting participants than the Discon-group ( $F(1, 23) = 13.3$ ,  $p < 0.01$ ), overall means being 76.3 ( $SD = 12.5$ ) and 48.5 ( $SD = 26.0$ ), respectively.

## DISCUSSION

The major results can be summarised as follows:

- (1) Selecting the counter-habitual 'defect' option elicited a blush response in pro-social individuals as indexed by physiological assessment, observational judgement, and selfreport ratings.
- (2) Relatively strong blush responses while defecting were related to relatively low rather than to relatively high levels of attributed trustworthiness.
- (3) The blush response of the participants whose interdependents continued with cooperation after being cheated was not relatively intense.

Sustaining the validity of the present experimental setup, the experimentally induced transgression was perceived as a considerably shameful event. That is, mean self-reported shame scores (within the experimental group) were substantially higher during the target trial than during the immediately preceding trial. The reliability of this finding is further sustained by the fact that also their interdependents (control participants) observed a stronger shame response in the experimental group during the target trial than during the preceding trial. In addition, the experimental group showed elevated levels of general arousal while defecting, indicating that they were emotionally affected (e.g. ashamed) by their choice behaviour. Together, these findings converge to the conclusion that the present experimental approach was successful in eliciting a shameful transgression under controlled conditions. Meanwhile, it should be acknowledged that the transgression in the present PDG differs from those of people in everyday life, as we instructed participants to violate a norm, whereas in everyday life people usually have a choice whether or not to violate a norm. Therefore, the present transgressors' emotional expressions will come closer to those of people who feel situationally forced to violate certain rules which they share with the (unexpected) observer, then to those of people who deliberately choose to violate certain norms. However, it is important to note that the exact mechanism that leads to the transgressors' emotional expressions is irrelevant for investigating its communicative and remedial effects on the observers, which is the primary aim of the present study.

### **Blushing After a Moral Transgression**

Corroborating previous findings based on a vignette methodology (de Jong, 1999, Experiment 3), the present study showed that also during real-time interactions violating a shared rule elicits a blush response (*hypothesis 1*). The various measures that were used in the current experiment were highly consistent in this respect. That is, compared to the immediately preceding trial the plethysmograph objectively registered a more intense facial coloration during the target trial, the interdependent 'victims' observed a stronger blush response, and the defecting participants themselves experienced a stronger blush response during the target trial. Meanwhile, there was no convincing correlation between the physiologically measured and subjectively observed intensity of the blush. The absence of such a correlation is a common finding (e.g. Shearn et al., 1990; Mulkens et al., 1999; Drummond, 2001; Drummond & Lim, 2000) and is probably due to differential skin properties (e.g. its tone, level of pigmentation, thickness) influencing the visual reddening of the skin during a blush response. The fact that in the present study the blush intensity of each defector was judged by a different observer might have further reduced the chance of finding a reliable correlation between the physiological and subjective intensity of the defectors' blush response.

### **Blushing and Global Evaluation**

The global personality characteristics that were attributed to the interdependent participants became considerably less positive after these individuals raised the 'defect' sign on the target trial. Yet this drop in 'social affection' was not modified by the strength of the observed blush response (*hypothesis 2*). Thus in contrast to the earlier vignette study (de Jong, 1999, Experiments 1 & 2), no evidence emerged to sustain the idea that blushing is effective in warding off negative attributions after a transgression. Apart from the fact that the previous study used imagined situations rather than real-time interactions there are several other differences that may (also) account for this apparent inconsistency.

First, the vignette study concerned a mild (nonintentional) mishap, whereas defecting, in the present study, was primed as being an immoral act. Thus one testable explanation for the discrepancy between both studies might be that blushing is only effective in modifying people's affective judgements in the

context of mild infractions. Second, and relatedly, the mishaps described in the vignettes occurred seemingly involuntary, whereas raising the 'defect' sign was obviously a voluntary act. It might well be that under such circumstances it requires more than nonverbal communication to restore what one has done wrong. Finally, in all previous studies showing a remedial effect of displays of embarrassment (e.g. Semin & Manstead, 1982; de Jong, 1999) or shame (e.g. Keltner et al., 1997), the participants who observed and evaluated the actors after a social/moral infraction were *not directly* involved in the pertinent social interaction. Relatedly, the actors themselves or a third party were the 'victims' of the transgression, but never the evaluating participant (as was the case in the present study). Because the hedonic relevance of the actor's behaviour lead an observer to make internal rather than external attributions for this behaviour (e.g. Jones & Davis, 1965), it might well be that being the victim of a transgression may give rise to the interpretation that the transgression reflects an habitual tendency of the actor, rather than a coincidence of situational factors. When a transgression is predominantly attributed to the actor's dispositions, this may undermine the otherwise remedial properties of blushing. One way to solve this issue is to include an independent observer in future research.

### Blushing and Trustworthiness

The present study revealed a significant relationship between the observable reddening of the face and the trustworthiness attributed to the defector (*hypothesis 2*). However, in contrast to the idea that blushing is a sign of moral integrity (e.g. Frank, 1988; Castelfranchi & Poggi, 1990), the present results indicate that blushing is related to low rather than to high levels of attributed trustworthiness. Thus, rather than serving a remedial function, blushing was found to inflate the negative influence of defecting on the actors' trustworthiness. In passing note that although blushing was related to observed shamefulness, observed shamefulness *per se* was not related to the defectors' trustworthiness. Thus, the present pattern of results suggests that the communicative properties of blushing are rather specific and not readily exchangeable with other signs of shame (cf. Keltner, 1995; Keltner & Buswell, 1997), perhaps because of the involuntary nature of the blush.

One explanation for the negative link between blushing and trustworthiness might follow from the fact that in the present context a noncooperative choice was said to be immoral, because of its negative consequences for the interdependent others (see above). Accordingly, in the present context, displaying a blush might serve as a signal for the 'victim' that the defector indeed shares the same moral values but at the same time behaves in an immoral way. It seems reasonable to argue that giving oneself away as being someone who does not follow her or his own moral principles might undermine one's trustworthiness. However, in apparent conflict with this explanation we recently found that even after a clear-cut voluntary socially unacceptable act (e.g. damaging a bicycle) blushing still sustained the actors' trustworthiness (De Jong, Peters, & De Cremer, 'Whoever blushes is already guilty': Revealing effects of blushing in the context of ambiguous social situations, 2001).

An alternative explanation for the apparent negative (rather than the alleged positive) influence of the blush in the present PDG might be that in the current context, 'victims' used the blush response to deduce and interpret the 'cheater's' motive. Note that in contrast to previous studies, the antecedent behaviour involved in the present study, though being obviously voluntary, is not unambiguous with respect to the perpetrators' intentionality. For example, raising the 'defect' sign on the *fourth* trial could be interpreted as innocent playing around (e.g. to prevent the experiment from getting boring), but also as an intentional (and thus unfair) act to maximise the outcomes for the self at the expense of the interdependent others. In such a context, displaying a blush may substantiate the observers' suspicion that the blusher has behaved in a socially inappropriate manner. That is, the observers might have interpreted blushing as a sign of *intentionality* ('true innocence doesn't need a blush'), and thus as

revealing the defectors' immoral motive. In its turn, such an interpretation is likely to have resulted in lower levels of attributed trustworthiness (cf. Semin, 1982). In line with such an explanation, a subsequent vignette study showed that blushing sustains the actors' trustworthiness after a mishap or voluntary moral transgression, but not in the context of situations that are ambiguous with respect to the (intentionality of) antecedent behaviours (de Jong et al., submitted, 2001). In the latter type of situations, blushing was interpreted as signalling that the situation should be interpreted as an intentional violation of a social standard resulting in lower levels of attributed trustworthiness.

Thus it appears that the functional properties of blushing may be context dependent. In case of unambiguous antecedent behaviours, blushing has face-saving qualities, but in the context of more ambiguous social situations blushing may serve a revealing rather than an appeasing function. Thus by virtue of its involuntary nature, blushing may sometimes unwantedly signify that the blusher has done or thought something undesirable. Because in most social situations there is some degree of ambiguity with respect to the elicitors of an individual's blush response, the unwanted 'revealing' effects of blushing may well prevail its appeasing functions in real life. This may help to explain why people generally consider blushing as an undesirable response (Shields et al., 1990) and some individuals even develop a phobia of blushing (Mulken et al., 2001).

### Blushing and Conciliatory Behaviour

Given the negative influence of blushing on the trustworthiness attributed to the defectors, it might not be very surprising that blushing did not stimulate conciliatory behaviours in the present context (*hypothesis 3*). Accordingly, the blush of the participants whose interdependents continued with cooperation on the fifth trial (i.e. after being cheated) was not significantly more intense (neither physiologically, nor observed) than the blush of the participants whose interdependents raised the 'defect' sign on the fifth trial. However, it should be acknowledged that in contrast to what would be expected on the basis of previous research (e.g. van Lange, 1999), the vast majority of the present (prosocial) participants continued cooperation after being cheated. That is, recent research (De Cremer & van Lange, 2001; van Lange, 1999) illustrated that particularly prosocials reciprocate defecting behaviour. Thus, it appears that other mechanisms might have been at work here that discouraged the victims to turn to a noncooperative strategy after being cheated, and which might have overruled the influence of blushing *per se*.

Perhaps the most important factor that might have played a role here is the fact that the game was framed as a test of moral behaviour. This was done to optimize the chance of eliciting a blush response in the defecting individuals; yet at the same time this procedure might have undermined the habitual strategy of the (prosocial) 'victims' to reciprocate defecting behaviour. Because both participants could clearly see each other as well as the research assistant, accountability effects might have further attenuated prosocials' habitual tendency to reciprocate interdependents' cheating behaviour (cf. De Cremer, Snyder, & Dewitte, 2001). Thus, before discarding blushing as a potential modulator of observers' behaviours, it would be important in future research to manipulate these characteristics of the present experimental set-up (e.g. by varying the framing of the experiment and varying the visibility of the interdependent participant/research assistant during the test).

### Future Research

All in all, the present pattern of results provide several leads for further research. First, it seems important in future studies to actually vary the level of ambiguity with respect to the actor's



intentionality in the context of real-time interactions. Such a strategy would allow us to test whether, indeed, the communicative properties of blushing vary as a function of the perceived intentionality of the transgressor. Second, the finding that the experimental procedure was successful in eliciting a physiologically detectable blush indicates that the present PDG might be useful to further investigate the dynamics of blushing as a function of individuals' social value orientation. According to Castelfranchi and Poggi's (1990) model, the blush response communicates to the observers that the actor shares their values despite the current violation. For being a reliable signal, this communicative account of blushing implies that the blush response should only emerge if the actor, indeed, shares the values of the observers. Thus in the context of the present experimental set-up, blushing should only emerge if the defectors as well as the interdependent participants are prosocial individuals (or when a prosocial defector assumes that the interdependent is prosocial).

Therefore, it would be worth while to examine whether the present results are robust by including also pro-self orientated individuals who aim at either enhancing outcomes for self with no or little regard to others' outcomes (i.e. individualists), or enhancing relative advantage over others' outcomes (i.e. competitors; Messick & McClintock, 1968). Among such individuals blushing should not be as easily elicited as in prosocials, because proselves tend to consider defecting as a sensible and intelligent strategy rather than as a moral transgression (e.g. van Lange, 1999).

Relatedly, one might expect that blushing has a different meaning in proselves than in prosocials. That is, proselves may infer from others' blushing that these individuals are exploitable rather than lacking trustworthiness, as was reported by the present group of prosocial participants (cf. Liebrand et al., 1986; the might versus morality effect). Thus, including both participants with a prosel self and participants with a prosocial value orientation may reveal more insights in the psychological meaning of blushing in interdependent contacts, and at the same time, such a strategy may also provide physiological support for the frequently observed differences in motivations between prosocials and proselves (see De Cremer & van Lange, 2001).

To conclude, then, the present approach opens a new avenue for investigating the context dependent dynamics as well as the context dependent communicative properties of blushing as a function of personality characteristics (such as social value orientation) of both the actors and the observers. Therefore, the present PDG might well be a fruitful approach for both emotion theorists who are interested in the functional properties of social emotions, and social psychologists who are interested in people's behaviour in interdependent situations as a function of their social value orientation.

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